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FORTY-NINE GENERATIONS IN THE DARK.¹

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Since the time Lamarck put forward the well-known theory of the transmission of acquired characters, this subject has been discussed pro and con by many writers; some believing that it is one of the guiding principles in the evolution of species; others that the transmission of an acquired character is an utter impossibility. I shall not attempt a review of the literature, as every book on heredity and evolution has its chapter devoted to that. In fact, it seems to me that there has been too much discussion and not enough experimental work. I believe it can justly be said that there has not been a single decisive experiment which proves or disproves the theory. They are all open to criticism in one way or another. The main argument which the opponents of the theory advance is that there has been no proof brought forward, and further there is no conceivable way in which an acquired character could be transmitted. On the other hand, the supporters believe that this is one of the easiest ways of explaining evolution and as it helps us out of many a difficulty it must be true.

Much interesting data has been collected, but none of it is conclusive. What we need at the present time is more experimental work to test the validity of the theory. With this attitude toward the subject, I started an experiment October 21, 1907, while at Columbia University to test the effect of darkness upon the common fruit fly, *Drosophila ampelophora*, and, if any effect was noticeable, to test its transmissibility. This seemed to be a suitable experiment as the present condition of cave animals is easiest explained by the assumption of the transmission of acquired characters.

The paper is not a finished report, but it may be of interest to scientific men to learn that such an experiment is in progress, and that this fly has been bred in the dark for forty-nine generations. Most certainly the length of time is rather short, but the

¹ Contribution from the Zoölogical Laboratory of Indiana University, No. 112.

number of generations is large when compared with longer lived animals. Forty-nine generations of mankind would cover about fifteen centuries of time.

The first changes noticeable in cave animals are the loss of color and the degeneration of the eyes. So far, in the case of the flies, no visible change in color has manifested itself. Sections of the eyes showed all parts perfectly normal. Although I have not succeeded in getting an accurate method of measuring it, there is a noticeable difference in their reactions to light. These flies are positively phototactic and if set free nearly always fly toward the light. Those bred in the dark are still positive, but they do not react so quickly nor do so many of them react. At the end of the tenth generation, this difference was noticeable. So noticeable, that when two vials, one containing flies bred in the light and the other in the dark, were shown to several people at the laboratory without them knowing what they were, they immediately remarked that one lot went toward the light much more quickly than the other. This tenth generation, after being bred in the light for one generation, still showed a difference but not quite so marked. Whether or not the flies of the forty-ninth generation are more sluggish in their reactions to light than those of the tenth generation is impossible for me to say as my method of testing is not sufficiently accurate. I expect to continue the experiment and hope later to devise a method by which I can test the reactions of each fly individually and thus see whether the effect of the darkness is a cumulative one.

Much discussion has centered around the question of the origin of cave faunas and several suggestions have been made in regard to its solution, but it seems pretty generally concluded that animals which now inhabit caves have entered them because they were originally dark-seeking forms. The present experiment shows that a positively phototactic animal might establish itself in a cave if it were accidentally enclosed in such a place and if a suitable food supply were present.

Since no changes have been produced in the color of the body or in the structure of the eyes by breeding the fruit fly in the dark for forty-nine generations, the question arises as to whether the length of time which these flies have been bred in the dark

is too short or whether they have reached a fixed condition in so far as variations toward adaptations for a cave life are concerned. We might extend it a little further and ask whether all animals would lose their color or whether their eyes would degenerate in a cave environment? In other words, is the environment alone responsible for the present condition of cave animals or is there an internal orthogenetic factor at work to which the environment serves as a stimulus? Eigenmann in his discussion of the origin of cave animals has stated that forms which now inhabit caves were predestined to become cave animals long before they ever entered a cave. That is, they had varied in a certain fixed direction, and these variations had tended to fit them for a cave existence. If such is the case, would the present cave animals have become blind and colorless if they had not entered caves?